FINAL

FACILITY-WIDE GROUNDWATER MONITORING ADDENDUM FOR 2018

Former Ravenna Army Ammunition Plant

Portage and Trumbull Counties, Ohio

June 21, 2018

Contract Number: W9133L-14-D-0008

Task Order Number: 0003

Prepared for:

National Guard Bureau

NGB-ZC-AQ
111 South George Mason Drive
Building 2, 4th Floor
Arlington, VA 22204-1373

Prepared by:

TEC-Weston Joint Venture

2496 Old Ivy Road, Suite 300
Charlottesville, VA 22903-4895

THIS PAGE INTENTIONALLY LEFT BLANK

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

The public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing the burden, to Department of Defense, Washington Headquarters Services, Directorate for Information Operations and Reports (0704-0188), 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.

PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ADDRESS.

1. REPORT DATE *(DD-MM-YYYY)*	2. REPORT TYPE	3. DATES COVERED *(From - To)*
6-21-2018	Technical	NA

4. TITLE AND SUBTITLE

Final Facility-Wide Groundwater Monitoring Addendum for 2018

5a. CONTRACT NUMBER

W9133L-14-D-0008

5b. GRANT NUMBER

NA

5c. PROGRAM ELEMENT NUMBER

NA

6. AUTHOR(S)

TEC-WESTON Joint Venture
2496 Old Ivy Road, Suite 300
Charlottesville, VA 22903-4895

5d. PROJECT NUMBER

NA

5e. TASK NUMBER

0003

5f. WORK UNIT NUMBER

NA

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

TEC-WESTON Joint Venture
2496 Old Ivy Road, Suite 300
Charlottesville, VA 22903-4895

8. PERFORMING ORGANIZATION REPORT NUMBER

NA

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

National Guard Bureau
NGB-ZC-AQ
111 South George Mason Drive
Building 2, 4th Floor
Arlington, VA 22204-1373

10. SPONSOR/MONITOR'S ACRONYM(S)

NGB-ZC-AQ

11. SPONSOR/MONITOR'S REPORT NUMBER(S)

NA

12. DISTRIBUTION/AVAILABILITY STATEMENT

Reference distribution page

13. SUPPLEMENTARY NOTES

None

14. ABSTRACT

The TEC-Weston Joint Venture (JV) is submitting this Final Facility-Wide Groundwater Addendum for 2018 in accordance with Contract Number W9133L-14-D-0008, Task Order Number 0003, to provide Groundwater and Environmental Investigation Services for the RVAAP-66 Facility-Wide Groundwater Area of Concern (AOC) at the Former Ravenna Army Ammunition Plant (RVAAP); now known as Camp Ravenna Joint Military Training Center (Camp Ravenna) in Portage and Trumbull Counties, Ohio.

15. SUBJECT TERMS

RVAAP-66, Groundwater Monitoring

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			Brent Ferry
U	U	U	SAR	61	19b. TELEPHONE NUMBER *(Include area code)* 512-651-7108

Reset

Standard Form 298 (Rev. 8/98)
Prescribed by ANSI Std. Z39.18

THIS PAGE INTENTIONALLY LEFT BLANK

Ohio Environmental Protection Agency

John R. Kasich, Governor
Mary Taylor, Lt. Governor
Craig W. Butler, Director

July 10, 2018

Mr. David Connolly
Army National Guard Directorate
ARNGD-ILE-CR
111 South George Mason Drive
Arlington, VA 22204

Re: US Army Ammunition Plt RVAAP
Remediation Response
Project Records
Remedial Response
Portage County
267000859036

Subject: Ravenna Army Ammunition Plant, Portage/Trumbull Counties. Approval of the "Final Facility-Wide Groundwater Monitoring Addendum for 2018" at the Former Ravenna Army Ammunition Plant, Portage and Trumbull Counties, Ohio, Dated June 21, 2018, Ohio EPA ID # 267-000859-036

Dear Mr. Connolly:

The Ohio Environmental Protection Agency (Ohio EPA) has received the "Final Facility-Wide Groundwater Monitoring Addendum for 2018" at the Former Ravenna Army Ammunition Plant, Portage and Trumbull Counties, Ohio, dated June 21, 2018, Ohio EPA ID # 267-000859-036. This document was received at Ohio EPA's Northeast District Office (NEDO), Division of Environmental Response and Revitalization (DERR) on June 25, 2018. The response was prepared for the Army National Guard Directorate by TEC-Weston Joint Venture.

The final document was reviewed by personnel from Ohio EPA's DERR and Division of Drinking and Ground Water (DDAGW). Pursuant to the Director's Findings and Orders paragraph 39 (b), Ohio EPA considers the document final and approved.

If you have any questions, please call me at (330) 963-1292.

Sincerely,

Kevin M. Palombo
Environmental Specialist
Division of Environmental Response and Revitalization

RECEIVED
11 JUL 2018

KP:cla

ec: Rebecca Shreffler, Chenega
Craig Coombs, USACE
Kevin Sedlak, ARNG
Rodney Beals, Ohio EPA, NEDO, DERR
Bob Princic, Ohio EPA, NEDO, DERR
Thomas Schneider, Ohio EPA, SWDO, DERR
Carrie Rasik, Ohio EPA, Central Office, DERR
David Connolly, ARNG
Nat Peters, USACE
Katie Tait, OHARNG RTLS
Mark Johnson, Ohio EPA, NEDO, DERR
Albert Muller, Ohio EPA, NEDO, DMWM

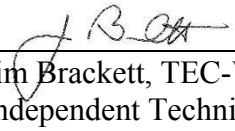
THIS PAGE INTENTIONALLY LEFT BLANK

CONTRACTOR STATEMENT OF INDEPENDENT TECHNICAL REVIEW

TEC-Weston Joint Venture (TEC-Weston JV) has completed the Final Facility-Wide Groundwater Monitoring Addendum for 2018. Notice is hereby given that an independent technical review has been conducted that is appropriate to the level of risk and complexity inherent in the project. During the independent technical review, compliance with established policy principles and procedures, utilizing justified and valid assumptions, was verified. This included review of data quality objectives; technical assumption; methods, procedures, and materials to be used; the appropriateness of data used and level of data obtained; and reasonableness of the results, including whether the product meets the customer's needs consistent with law and existing National Guard Bureau policy.

06/21/2018

E. Michael Chapa, TEC-Weston JV — Date
Study/Design Team Leader



06/21/2018

Jim Brackett, TEC-Weston JV — Date
Independent Technical Review Team Leader

Significant concerns and the explanation of the resolutions are as follows:

THIS PAGE INTENTIONALLY LEFT BLANK

Final

FACILITY-WIDE GROUNDWATER MONITORING ADDENDUM FOR 2018

Former Ravenna Army Ammunition Plant

Portage and Trumbull Counties, Ohio

June 21, 2018

Contract Number: W9133L-14-D-0008-0003

Task Order Number: 0003

Prepared for:

National Guard Bureau

NGB-ZC-AQ
111 South George Mason Drive
Building 2, 4th Floor
Arlington, VA 22204-1373

Prepared by:

TEC-Weston Joint Venture

2496 Old Ivy Road, Suite 300
Charlottesville, VA 22903-4895

THIS PAGE INTENTIONALLY LEFT BLANK

DOCUMENT DISTRIBUTION

for the

Facility-Wide Groundwater Monitoring Addendum for 2018

Former Ravenna Army Ammunition Plant

Portage and Trumbull Counties, Ohio

Name/Organization	Number of Printed Copies	Number of Electronic Copies
Kevin Palombo, Ohio EPA, DERR-NEDO	1	3
Dave Connolly, ARNG-ILE	0	1
Katie Tait, OHARNG-Camp Ravenna	1	0
Kevin Sedlak, ARNG-Camp Ravenna	0	1
Gail Harris, Chenega	1	2
Brent Ferry, TEC-Weston JV Project Manager	0	1 (Electronic only)
	3 HC	7 CD

Rod Beals, Ohio EPA NEDO — 1 HC of transmittal letter only
Al Muller, Ohio EPA NEDO — 1 HC of transmittal letter only
Bob Princic, Ohio EPA NEDO — 1 HC of transmittal letter only
Tom Schneider, Ohio EPA, SWDO — 1 HC of transmittal letter only

ARNG = Army National Guard
NGB = National Guard Bureau
OHARNG = Ohio Army National Guard

THIS PAGE INTENTIONALLY LEFT BLANK

TABLE OF CONTENTS

LIST OF APPENDICES

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS AND ABBREVIATIONS

µg/L	micrograms per liter
AOC	Area of Concern
ARNG	Army National Guard
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
DFFO	Director's Final Finding and Order
DoD	Department of Defense
EQM	Environmental Quality Management, Inc.
FS	Feasibility Study
FWCUG	facility-wide cleanup goal
FWGW	Facility-Wide Groundwater
FWGWM	Facility-Wide Groundwater Monitoring
FWGWMP	Facility-Wide Groundwater Monitoring Program
FWGWMPP	Facility-Wide Groundwater Monitoring Program Plan
GC	gas chromatography
IRP	Installation Restoration Program
MCL	maximum contaminant level
MS	mass spectrometry
NGB	National Guard Bureau
OHARNG	Ohio Army National Guard
Ohio EPA	Ohio Environmental Protection Agency
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
QAPP	Quality Assurance Project Plan
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
RSL	Regional Screening Level
RVAAP	Ravenna Army Ammunition Plant
s.u.	standard units
SAP	Sampling and Analysis Plan
SRC	site related compound

SVOC	semivolatile organic compound
TEC-Weston JV	TEC-Weston Joint Venture
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
VOC	volatile organic compound

THIS PAGE INTENTIONALLY LEFT BLANK

EXECUTIVE SUMMARY

The Facility-Wide Groundwater Monitoring (FWGWM) Addendum for 2018 is a supplement to the Facility-Wide Groundwater Monitoring Program Plan (FWGWMPP) and discusses the subset of currently existing monitoring wells at the former Ravenna Army Ammunition Plant (RVAAP) in Portage and Trumbull Counties, Ohio, that will be monitored in Spring and Fall 2018 and the contaminants of potential concern that will be evaluated at each selected well. This document supersedes the *Final Facility-Wide Groundwater Monitoring Addendum for 2017*, dated April 27, 2017, for the groundwater sampling that began with the Spring 2017 event, conducted in April/May 2017, and continued through the Fall 2017 sampling event, conducted in November/December 2017.

Eighty wells have been identified for Facility-Wide Groundwater Monitoring Program (FWGWMP) semiannual sampling in 2018 to evaluate potential off-site migration, potential source area attenuation, and temporal fluctuations. Based on a review of 2017 sampling results, one well sampled as part of the 2017 FWGWMP and 19 wells sampled in 2017 for the purposes of the Facility-Wide Groundwater Remedial Investigation [RI] will not be included in the 2018 semiannual program. Under this addendum, the following changes to the FWGWMP will be conducted in 2018 (* - indicates wells installed in 2016 as part of the FWGW RI):

- One well sampled as part of the 2017 FWGWMP will not be included in the 2018 semiannual program: FWGmw-002. The monitoring well will no longer be monitored for pH conditions based on only one result out of normal range reported for the well during its sampling history.
- Wells sampled as part of the FWGW RI in 2016 or 2017 that have been added to the 2018 FWGWMP semiannual sampling: CBLmw-001, CBLmw-002, CBLmw-003, CBLmw-004, LL4mw-200, LL1mw-089*, LL2mw-272*, FWGmw-017*, FWGmw-018*, FWGmw-019*, FWGmw-020*, FWGmw-021*, FWGmw-022*, FWGmw-023*, FWGmw-024*, LL1mw-089*, LL2mw-272*, and NTAmw-120*.
- Facility-Wide Groundwater RI wells included in the *Final Facility-Wide Groundwater Monitoring Addendum for 2017* that will not be sampled in 2018: BKGmw-008, B12mw-011, B12mw-012, LL1mw-063, LL2mw-270, LL3mw-236, LL4mw-194, LL5mw-001, LL6mw-001, LL6mw-002, LL6mw-006, LL12mw-189, FBQmw-166, LNWmw-026,

NTAmw-116, MBSmw-004, MBSmw-006, RQLmw-017, and WBGmw-015. The need for additional evaluation or sampling of groundwater conditions at these wells will be conducted as part of the pending RI.

1.0 BACKGROUND

The Army National Guard (ARNG) is performing Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) investigation and cleanup at the former Ravenna Army Ammunition Plant (RVAAP) located in Portage and Trumbull Counties near Ravenna, Ohio. CERCLA investigation and cleanup are occurring under the United States Department of Defense (DoD) Installation Restoration Program (IRP). Activities include monitoring of an extensive network of groundwater monitoring wells to determine nature and extent of groundwater impacts, to provide additional information in support of hydrogeologic and fate-and-transport models, to evaluate potential exit pathways, and to evaluate vertical contaminant distribution and/or particle inflow/outflow through the central portion of the facility. The June 2004 Ohio Environmental Protection Agency (Ohio EPA) Director's Final Findings and Orders (DFFOs) for the former RVAAP established a Facility-Wide Groundwater Monitoring Program Plan (FWGWMPP). This addendum to the FWGWMPP has been prepared by TEC-Weston Joint Venture (TEC-Weston JV) under Contract Number W9133L-14-D-0008 Task Order Number 0003, Groundwater and Environmental Investigation Services for the RVAAP-66 Facility-Wide Groundwater Area of Concern (AOC) at the Former RVAAP.

From 2005 through 2007, the United States Army Corps of Engineers (USACE) developed a database of groundwater quality information based on the sampling of approximately 36 monitoring wells. Beginning in fiscal year 2008, the Facility-Wide Groundwater Monitoring Program (FWGWMP) was expanded to include the characterization of groundwater from 243 existing monitoring wells at the facility.

An additional 41 wells were installed during 2012 to 2013 necessary to supplement the hydrogeologic system modeling and to conduct contaminant fate-and-transport modeling for a facility-wide groundwater approach in support of completion of a Remedial Investigation/Feasibility Study (RI/FS). The approach for installing these wells was described in the approved *Final Facility-Wide Groundwater Monitoring Program Plan RVAAP-66 Facility-Wide Groundwater Semiannual Monitoring Addendum*, dated January 6, 2012 (Environmental Quality Management, Inc. [EQM], 2012a), and supplemented by the *Final Facility-Wide Groundwater Monitoring Program Plan, RVAAP-66 Facility-Wide Groundwater Semiannual Groundwater Monitoring Addendum*, dated February 20, 2015 (EQM, 2015). A description of the

installation of the initial 38 wells is presented in the approved *Final Facility-Wide Groundwater Monitoring Program RVAAP-66 Facility-Wide Groundwater Monitoring Well Installation Report,* dated December 18, 2012 (EQM, 2012b). Information regarding installation of the three additional RI wells is included in Appendix B of the *Draft Facility-Wide Groundwater Monitoring Program RVAAP-66 Facility-Wide Groundwater Monitoring Report on the January 2014 Sampling Event*, dated May 9, 2014 (EQM, 2014). The January 2012 *Facility-Wide Groundwater Monitoring Program Plan RVAAP-66 Facility-Wide Groundwater Semiannual Monitoring Addendum* (EQM, 2012a) modified the FWGWMP from quarterly to a semiannual basis.

The Semiannual Monitoring Addendum was revised in 2013 to address semiannual monitoring beginning with the July 2013 event and continuing through the July 2014 sampling event. Forty-two wells (including the 5 Resource Conservation and Recovery Act [RCRA] wells) were selected for sampling during the semiannual events in 2013 and 2014. The 2015 and 2016 FWGWMP included semiannual monitoring for 46 wells, 4 of which were monitored for pH only (the total number of wells evaluated for pH and associated secondary geochemical parameters was expanded for RI sampling conducted during the Fall 2016 event).

Facility-Wide Groundwater RI activities in 2016 included sampling of 124 previously existing wells and the installation of 11 new monitoring wells for evaluation of the current nature and extent of groundwater contamination at the former RVAAP (see the *Final Remedial Investigation Work Plan for Groundwater and Environmental Investigations Services for RVAAP-66 Facility-Wide Groundwater*, dated December 21, 2016, for details on locations selected for the newly installed wells [TEC-Weston JV, 2016]). The RI field activities included installation of four wells for the purposes of completing a background study for metals. Sampling results for these wells and evaluation of background conditions for inorganic constituents will be provided in the pending RVAAP-66 Facility-Wide Groundwater RI Report.

As described in the *Final Facility-Wide Groundwater Monitoring Addendum for 2017* (2017 Facility-Wide Groundwater [FWGW] Addendum) (TEC-Weston JV, 2017a), dated April 27, 2017, 96 previously existing wells and new wells that were installed in 2016 at the former RVAAP were included in FWGWMP semiannual or continued RI sampling in 2017 to evaluate potential off-site migration, potential source area attenuation, and temporal fluctuations. An additional 13

wells were sampled for the purposes of the metals background study being conducted in association with the FWGW RI. Nine of the wells proposed for sampling in the Addendum for 2017 were not sampled because of dry conditions, insufficient groundwater levels for sampling, or elevated turbidity in one or both of the April and December events. A summary of results of groundwater monitoring activities conducted in 2017, including a screening to current regulatory standards, is provided in the *Draft Facility-Wide Groundwater Monitoring Program, RVAAP-66 Facility-Wide Groundwater, Annual Report for 2017* (2017 FWGWMP Annual Report) (TEC-Weston JV, 2017b).

THIS PAGE INTENTIONALLY LEFT BLANK

2.0 PURPOSE OF ADDENDUM

This Addendum provides an update to the FWGWMPP for 2018, including the identification of wells to be sampled as part of the semiannual FWGWMP. The initial four quarters of monitoring and sampling for wells installed in 2016 as part of FWGW RI activities were completed in 2017. Select constituents for 11 of these wells are included for addition to the 2018 FWGWMP based on compounds detected during the initial rounds of sampling and on the general function of the individual wells (e.g., base boundary groundwater exit-pathway monitoring). Results for the four new wells installed in 2016 as part of the facility-wide metals background study have not been evaluated for potential incorporation into the 2018 FWGWMP.

The primary objectives of the 2018 facility-wide monitoring well network are to assess potential exit pathways and to monitor contaminant levels tied to historical RVAAP activities (e.g., explosives/propellants, volatile organic compounds [VOCs], semivolatile organic compounds [SVOCs], pesticides, and polychlorinated biphenyls [PCBs]) at selected source area wells for trend analysis. Metals concentrations will also be determined in groundwater, but the evaluation of the nature and extent of metals constituents representing a release requiring a corrective action response will be deferred pending Ohio EPA approval of the background study being conducted as part of the FWGW RI.

Results of the 2017 FWGWMP sampling were reviewed to determine the presence of site related compounds (SRCs) and to evaluate contaminant concentration trends within individual wells. Except for review of results for the 11 new RI wells installed in 2016 and of total cyanide results at LL4mw-200 (because of its proximity to the Camp Ravenna boundary), evaluation of RI well results from 2017 will be included in the pending FWGW RI Report. Wells were selected for inclusion in the 2018 Semiannual FWGWMP based on the following criteria:

- FWGWMP Criterion 1: Wells representing critical exit pathway monitoring points (generally a carryover from the 2017 program).
- FWGWMP Criterion 2: Wells representing primary AOC-specific contaminant source area conditions indicated to be potentially increasing or otherwise potentially unstable plume conditions.

- FWGWMP Criterion 3: Wells with 2016 or 2017 sampling results representing a historical maximum concentration above regulatory screening levels for one or more SRCs in groundwater (based on AOC-specific sampling histories).
- FWGWMP Criterion 4: Co-located wells used to establish the vertical distribution of contaminants within the stratigraphic sequence.
- FWGWMP Criterion 5: New wells installed during 2016 as part of the FWGW RI and sampled for four quarters as of December 2017 (excludes wells installed for the purposes of the facility-wide metals background study).

Contaminant trend analysis of the 2017 sampling results was conducted by review of well specific sampling histories and time series graphs provided in the *Facility-Wide Groundwater Monitoring Program RVAAP-66 Facility-Wide Groundwater Annual Report for 2017* (2017 Annual Report) (TEC-Weston JV, 2017c) and as described in *Appendix A* of the *2017 FWGWM Addendum*. Only one 2017 FWGWMP well (FWGmw-002) has not been carried over into the 2018 semiannual program. No reductions in constituent suites from 2017 have been proposed for the 2018 program other than testing for alkalinity at FWGmw-002. C-Block Quarry wells sampled in 2016, as part of the RI, have been added to the 2018 FWGWMP as Criterion 2 wells based on EPA comments to the ARNG on the *Revised Draft RI/FS for Soil, Sediment and Surface Water at RVAAP-06 C-Block Quarry* (Leidos, 2017). Other minor additions to the analytical testing suite from 2017 proposed for 2018 are discussed in Section 3.0.

3.0 SCOPE OF WORK UNDER THE ADDENDUM

The proposed 2018 FWGWMP monitoring well network is intended to further address AOC-specific nature and extent data gaps in the historical sampling dataset as described in the 2017 FWGWM Addendum and as indicated by results of the 2017 groundwater sampling program. To this end, 80 wells (including 5 RCRA wells) have been selected for sampling during the semiannual events in 2018. Monitoring well sampling and analytical testing will be conducted in accordance with the Sampling and Analysis Plan (SAP) and Quality Assurance Project Plan (QAPP) updates provided with the *Final Facility-Wide Groundwater RI Work Plan* (TEC-Weston JV, 2016).

The 2017 groundwater data were screened in the 2017 Annual Report (TEC-Weston JV, 2017c), in part using the approach presented in the *Facility-Wide Groundwater Monitoring Program Plan RVAAP-66 Facility-Wide Groundwater Semiannual Monitoring Addendum* (EQM, 2012a). In general, the applicable screening standard is the lower of facility-wide cleanup goals (FWCUGs) for those constituents with a FWCUG, or the lower of the United States Environmental Protection Agency (USEPA) maximum contaminant levels (MCLs) and the most recent USEPA tapwater regional screening levels (RSLs) for constituents without a FWCUG. Results for facility-boundary wells were compared to USEPA screening levels regardless of whether they have an established FWCUG.

Although 2016 RI sampling results for Q-Block Quarry wells indicated non-detect concentrations for each of the parameters tested (SVOCs, PCBs and cyanide), CBLmw-001 through CBLmw-004 have been added to the 2018 FWGWMP based on EPA comments to the ARNG on the *Revised Draft RI/FS for Soil, Sediment and Surface Water at RVAAP-06 C-Block Quarry* (Leidos, 2017). The wells will be sampled for metals, including hexavalent chromium, sulfate/sulfite, nitrate/nitrite, and alkalinity, in addition to testing of those parameters included in the 2016 RI sampling event.

Evaluation of 2017 FWGWMP sampling results included the review of data validation reports and determining the effects, if any, of applied data qualifiers on data usability. Data validation reports for all samples collected in 2017 were provided with the *Final Facility-Wide Groundwater Monitoring Program, RVAAP-66 Facility-Wide Groundwater, Semi-Annual Report for April and*

July 2017 Sampling Events (TEC-Weston JV, 2018) and the *Preliminary Draft Facility-Wide Groundwater Monitoring Program, RVAAP-66 Facility-Wide Groundwater Annual Report for 2017* (TEC-Weston JV, 2017c). No additional sampling in support of the FWGW RI is recommended in 2018, except for planned sampling of the 11 new RI wells installed in 2016 and of total cyanide at LL4mw-200 (because of its proximity to the Camp Ravenna boundary). Evaluation of RI well results from 2017 will be included in the pending FWGW RI Report.

3.1 pH Monitored Wells

Selection of existing wells for semiannual pH monitoring was made based on anomalous pH values outside the typical range of natural groundwater (i.e., 5 to 9 standard units [s.u.]). As was generally provided in the 2017 FWGWMP, 11 wells will be tested in 2018 for alkalinity, sulfate/sulfide, nitrate/nitrite, and/or hexavalent chromium:

- Homewood Aquifer: FBQmw-171; FBQmw-174; FBQmw-175.
- Unconsolidated Aquifer: LL1mw-086 (alkalinity only); LL1mw-088 (alkalinity only).
- Upper Sharon Sandstone: LL1mw-083; LL1wmw-084; RQLmw-011; RQLmw-012; RQLmw-013; RQLmw-014.

The annual FWGWMP reporting for these wells will include time-series graphs for pH values. An evaluation of secondary geochemical parameters potentially associated with the anomalous pH conditions will be provided in the pending FWGW RI Report. FWGmw-002 will no longer be monitored for pH conditions based on only one result out of normal range reported for the well during its sampling history.

3.2 New Wells Installed in 2016

Fifteen new monitoring wells were installed at the facility in August to December 2016 to further characterize the nature and extent of FWGW impacts and for the purposes of a metals background study. A summary of monitored aquifers, new well identification numbers, and general locations is a follows (four of the new wells were installed for the background study and are not included in the summary below):

- Basal Sharon Conglomerate Aquifer: FWGmw-017 (post-boundary southeast of Load Line 2); FWGmw-018 (post-boundary south of Load Line 12); FWGmw-019 (between Load Line 9 and Load Line 10).
- Upper Sharon Sandstone Aquifer: FWGmw-020 (post-boundary south of Load Line 12); FWGmw-021 (post-boundary southwest of Load Line 3); FWGmw-022 (between Load Line 9 and Load Line 10); FWGmw-023 (east of Fuze and Booster Quarry); FWGmw-024 (post-boundary southeast of Load Line 2); LL1mw-089 (eastern interior Load Line 1 area); LL2mw-272 (southwest interior Load Line 2 area); NTAmw-120 (central NACA Test Area).

Analytes detected over current screening levels to date include the following (* - indicates Camp Ravenna boundary well results below the FWCUG but above the USEPA Tapwater RSL):

- VOCs: Chloroform (FWGmw-019; FWGmw-022; FWGmw-023) and ethylbenzene (FWGmw-023).
- SVOCs: Indeno(1,2,3-cd)pyrene (LL1mw-089).
- Explosives: 2-Amino-4,6-dinitrotoluene and 4-Amino-2,6-dinitrotoluene (FWGmw-021); nitrobenzene* (FWGmw-024).
- PCBs: Aroclor-1254 (FWGmw-019; FWGmw-018; FWGmw-022; FWGmw-021).
- Cyanide: FWGmw-019; FWGmw-023; LL1mw-089; FWGmw-022; FWGmw-020; LL2mw-272; FWGmw-021.
- Metals: Antimony (FWGmw-019; FWGmw-023; FWGmw-022); arsenic (all wells); hexavalent chromium (FWGmw-024); cobalt (all wells); iron (FWGmw-023; FWGmw-022; FWGmw-020; FWGmw-024; LL2mw-272; FWGmw-021; NTAmw-120); manganese (all wells); nickel (FWGmw-022); thallium (FWGmw-019; LL1mw-089).

All wells and non-metals constituents with screening level exceedances will generally be included in the 2018 FWGWMP, with the following exceptions/additions:

- Further evaluation of metals will be deferred for facility-interior well locations (FWGmw-019; FWGmw-022; FWGmw-023; LL1mw-089; and NTAmw-120) pending completion of the background study.

- Wells installed at the Camp Ravenna boundary along State Route 5 will be sampled for all constituents detected in 2017, regardless of concentrations above or below current screening levels. In addition, these wells will be monitored during 2018 for constituents associated with upgradient AOCs (including metals), regardless of whether these constituents were detected in previous sampling.
- Hexavalent chromium, nitroguanidine, nitrocellulose, and perchlorate were not sampled during the initial quarterly sampling for all wells installed in 2016 (FWGmw-017 through FWGmw-024, LL1mw-089, LL2mw-272, and NTAmw-120) and will be included in the Spring 2018 event. The need for additional sampling for these constituents in the fall event will be determined based on the spring sampling results.

3.3 RCRA Wells

RCRA wells specified by DFFOs will be sampled semiannually as FWGWMP wells. The RCRA wells include the Ramsdell Quarry Landfill wells (RQLmw-007; RQLmw-008; and RQLmw-009) and the Open Demolition Area #2 wells (DET-3 and DET-4). The sampling suite for these wells has been revised from 2017 to no longer include pesticides, based on no detections of these constituents since 2014 or earlier. Although these wells were designated as RCRA wells, they are being monitored as part of the CERCLA program at Camp Ravenna per the DFFOs and will be included in evaluations conducted as part of the pending RI.

3.4 CERCLA Wells

Selection of wells for the semiannual FWGWMP was made based on consideration of the following criteria. Wells in the below bulleted list denoted with an asterisk (*) indicate wells that meet more than one of the criteria for additional sampling. A description of the well selection rationale for wells listed below and included in the 2018 FWGWMP is provided on **Table 3-1**.

- FWGWMP Criterion 1: wells representing critical exit pathway monitoring points (i.e., located along the Camp Ravenna boundary):
    - Basal Sharon Conglomerate Aquifer: SCFmw-004, FWGmw-017, FWGmw-018
    - Upper Sharon Sandstone Aquifer: LL2mw-059*, LL3mw-237, LL3mw-244, LL3mw-246, FWGmw-012, FWGmw-016, FWGmw-020, FWGmw-021, FWGmw-024

- Unconsolidated Aquifer: LL1mw-064, LL1mw-065, LL1mw-086, LL1mw-087, LL1mw-088*, LL4mw-200, LL12mw-247, FWGmw-004, FWGmw-007, FWGmw-011*, FWGmw-015

- FWGWMP Criterion 2: Wells representing primary AOC-specific contaminant source area conditions routinely monitored (e.g., RCRA monitoring well locations) or indicated to be potentially increasing or otherwise potentially unstable plume conditions.
  - Homewood Aquifer: CBLmw-001, CBLmw-002, CBLmw-003, CBLmw-004, FBQmw-174, FBQmw-175, LL7mw-001*, LL7mw-006*, LL10mw-003*
  - Upper Sharon Sandstone Aquifer: CBPmw-009*, EBGmw-131*, FWGmw-023, LL1mw-080, LL1mw-081*, LL1mw-083, LL1mw-084*, LL2mw-059*, LL2mw-264*, LL2mw-267, RQLmw-007*, RQLmw-008*, RQLmw-011, RQLmw-012, RQLmw-013, RQLmw-014
  - Sharon Shale Aquifer: none currently proposed
  - Basal Sharon Conglomerate Aquifer: none currently proposed
  - Unconsolidated Aquifer: CBPmw-008, EBGmw-125*, LL1mw-086*, LL1mw-088, LL4mw-193*, LL4mw-200*, LL12mw-185, LL12mw-242, LL12mw-245, LL12mw-247, FBQmw-176, NTAmw-119*, WBGmw-006*, WBGmw-009*
- FWGWMP Criterion 3: wells with 2016 or 2017 non-metals sampling results (includes cyanide) representing a historical maximum concentration for one or more SRCs in groundwater (based on AOC-specific sampling histories, does not include RI wells installed in 2016).
  - Homewood Aquifer: FBQmw-171, FBQmw-172, LL7mw-001, LL7mw-006*, LL10mw-003*
  - Upper Sharon Sandstone Aquifer: CBPmw-009, DA2mw-115*, EBGmw-131*, FWGmw-013*, LL1mw-081*, LL1mw-084*, LL2mw-059*, LL2mw-264*, LL3mw-234, LL12mw-183, RQLmw-007*, RQLmw-008*, RQLmw-009, RQLmw-012, RQLmw-016
  - Basal Sharon Conglomerate Aquifer: none currently proposed

- Unconsolidated Aquifer: DETmw-003*, EBGmw-125*, FWGmw-010, FWGmw-011*, LL4mw-193*, LL4mw-200*, LL11mw-005, LL12mw-187, LL12mw-247, NTAmw-117, NTAmw-118, NTAmw-119*

- FWGWMP Criterion 4: collocated wells used to evaluate the vertical distribution of contaminants within the stratigraphic sequence (includes all wells installed to date).

  - East of Ramsdell Quarry Landfill AOC: FWGmw-11 (Unconsolidated Aquifer); FWGmw-012 (Upper Sharon Sandstone Aquifer)
  - Erie Burning Grounds AOC: EBGmw-125 (Unconsolidated Aquifer); EBGmw-131 (Upper Sharon Sandstone Aquifer)
  - Load Line 10 AOC: LL10mw-005 (Homewood): FWGmw-022 (Upper Sharon Sandstone Aquifer); FWGmw-019 (Basal Sharon Conglomerate Aquifer)
  - Post boundary at Load Line 12 AOC: FWGmw-020 (Upper Sharon Sandstone Aquifer); FWGmw-018 (Basal Sharon Conglomerate Aquifer)
  - Post Boundary at Load Line 2 AOC: FWGmw-024 (Upper Sharon Sandstone Aquifer); FWGmw-017 (Basal Sharon Conglomerate Aquifer)
  - Open Detonation Area 2 AOC: DETmw-003* (Unconsolidated Aquifer); DA2mw-115* (Upper Sharon Sandstone Aquifer)
  - Winklepeck Burning Grounds AOC: WBGmw-009* (Unconsolidated Aquifer); WBGmw-020 (Upper Sharon Sandstone Aquifer)
  - Winklepeck Burning Grounds AOC: WBGmw-006* (Unconsolidated Aquifer); WBGmw-021 (Upper Sharon Sandstone Aquifer)
  - NACA Test Area AOC: NTAmw-120 (Upper Sharon Sandstone Aquifer, at large vertical delineation for Unconsolidated Aquifer underling the NACA Test Area)
  - Post Boundary south of the Camp Ravenna Main Cantonment Area: FWGmw-015* (Unconsolidated Aquifer); FWGmw-016 (Upper Sharon Sandstone Aquifer).

Results for 2017 metals constituent testing indicated screening level exceedances for aluminum, antimony, arsenic, cadmium, hexavalent chromium, cobalt, iron, lead, manganese, nickel, phosphorous, thallium, and vanadium. Based on the still pending status of the background metals study to be completed as part of the FWGW RI, all 2017 FWGWMP locations tested for metals

will be carried forward into the 2018 program, with the exception of new facility-interior wells installed as part of the RI in 2016 (FWGmw-019; FWGmw-022; FWGmw-023; LL1mw-089; and NTAmw-120). Metals sampling in 2018 will include new wells installed in 2016 as part of the RI at the Camp Ravenna boundary along State Route 5. Q-Block Quarry wells will also be sampled for metals, including hexavalent chromium.

Review of 2017 sampling results for cyanide testing indicates a range of concentrations generally consistent with 2016 testing. Detected concentrations were generally less than 10 micrograms per liter (µg/L) (all detections exceed the current screening level) except for at EBGmw-125 (19 µg/L for total cyanide and 29 µg/L for free cyanide in April 2017) and at CBPmw-009 (12 µg/L in December 2107). Twenty of the 28 FWGWMP and RI wells with detections in 2017 were reported with historical high or first time constituent detected concentrations (see **Table 3-1**). Seven of the 20 wells with historical high results in 2017 were new RI wells installed in 2016. All of the wells with historical maximum detected concentrations in 2017 are proposed as 2018 FWGWMP wells, except for RI well BKGmw-008. Evaluation of potential additional sampling of cyanide at BKGmw-008 will be deferred to the pending FWGW RI. Review of free cyanide results as compared to total cyanide concentrations has also been deferred to pending RI.

Table 3-1 provides a comprehensive summary of the proposed wells and rationale for their inclusion in the FWGW monitoring program. **Figures 3-1** through **3-3** show the wells to be sampled during the semiannual monitoring events.

The list of analytes for the selected FWGWMP reflects the primary constituents of concern within certain areas of the site or immediately downgradient of potential source areas, as appropriate. The refined analyte list for the semiannual wells is presented in **Table 3-2**. The analytical methods for these analytes are provided in **Table 3-3**. Evaluation of data collected during 2018 will be conducted in accordance with the Final Facility-Wide Groundwater RI Work Plan, including the supporting SAP and QAPP updates (TEC-Weston JV, 2016).

THIS PAGE INTENTIONALLY LEFT BLANK

4.0 SCHEDULE

A schedule for field sampling and reporting associated with the 2018 FWGWMP is provided as **Figure 4-1**.

THIS PAGE INTENTIONALLY LEFT BLANK

5.0 REFERENCES

EQM (Environmental Quality Management, Inc.). 2012a. *Final Facility-Wide Groundwater Monitoring Program Plan, RVAAP-66 Facility-Wide Groundwater Semiannual Monitoring Addendum*. 6 January 2012.

EQM. 2012b. *Final Facility-Wide Groundwater Monitoring Program RVAAP-66 Facility-Wide Groundwater Monitoring Well Installation Report.* 18 December 2012.

EQM. 2014. *Draft Facility-Wide Groundwater Monitoring Program RVAAP-66 Facility-Wide Groundwater Monitoring Report on the January 2014 Sampling Event*. 9 May 2014.

EQM. 2015. *Final Facility-Wide Groundwater Monitoring Program Plan, RVAAP-66 Facility-Wide Groundwater Semiannual Groundwater Monitoring Addendum for 2015*. 20 February 2015.

Leidos. 2017. *Revised Draft Remedial Investigation/Feasibility Study Report for Soil, Sediment, and Surface Water at RVAAP-06 C Block Quarry*. 4 August 2017.

TEC-Weston JV (TEC-Weston Joint Venture). 2016. *Final Remedial Investigation Work Plan for Groundwater and Environmental Investigations Services for RVAAP-66 Facility-Wide Groundwater*. 21 December 2016.

TEC-Weston JV. 2017a. *Final Facility-Wide Groundwater Monitoring Addendum for 2017.* April 2017.

TEC-Weston JV. 2017b. *Draft Facility-Wide Groundwater Monitoring Program, RVAAP-66 Facility-Wide Groundwater, Annual Report for 2017*

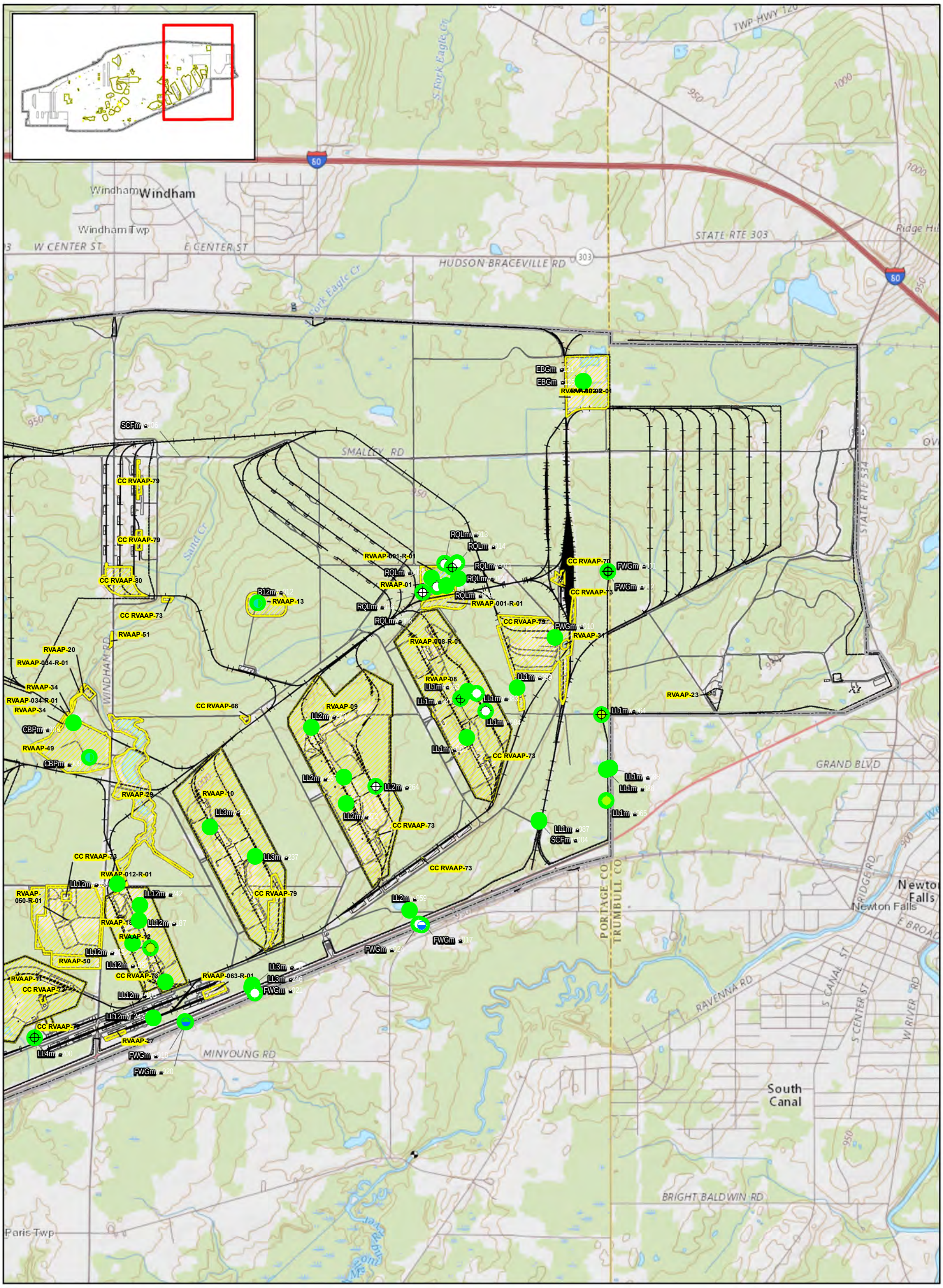
TEC-Weston JV. 2017c. *Facility-Wide Groundwater Monitoring Program RVAAP-66 Facility-Wide Groundwater Annual Report for 2017* (2017 Annual Report).

TEC-Weston JV. 2018. *Final Facility-Wide Groundwater Monitoring Program, RVAAP-66 Facility-Wide Groundwater, Semi-Annual Report for April and July 2017 Sampling Events. March 2018.*

THIS PAGE INTENTIONALLY LEFT BLANK

FIGURES

THIS PAGE INTENTIONALLY LEFT BLANK



Legend

- Groundwater Station (Unconsolidated Unit)
- Groundwater Station (Homewood)
- Groundwater Station (Sharon Sandstone)
- Groundwater Station (Sharon Shale)
- Groundwater Station (Sharon Cong.)
- 2018 FWGWMP Sampling Well Location
- Camp Ravenna Boundary
- AOCs/MRSs

N

0 1,300 2,600 3,900 5,200 Feet

1 " = 2,500 ft
NAD83 UTM Zone 17N

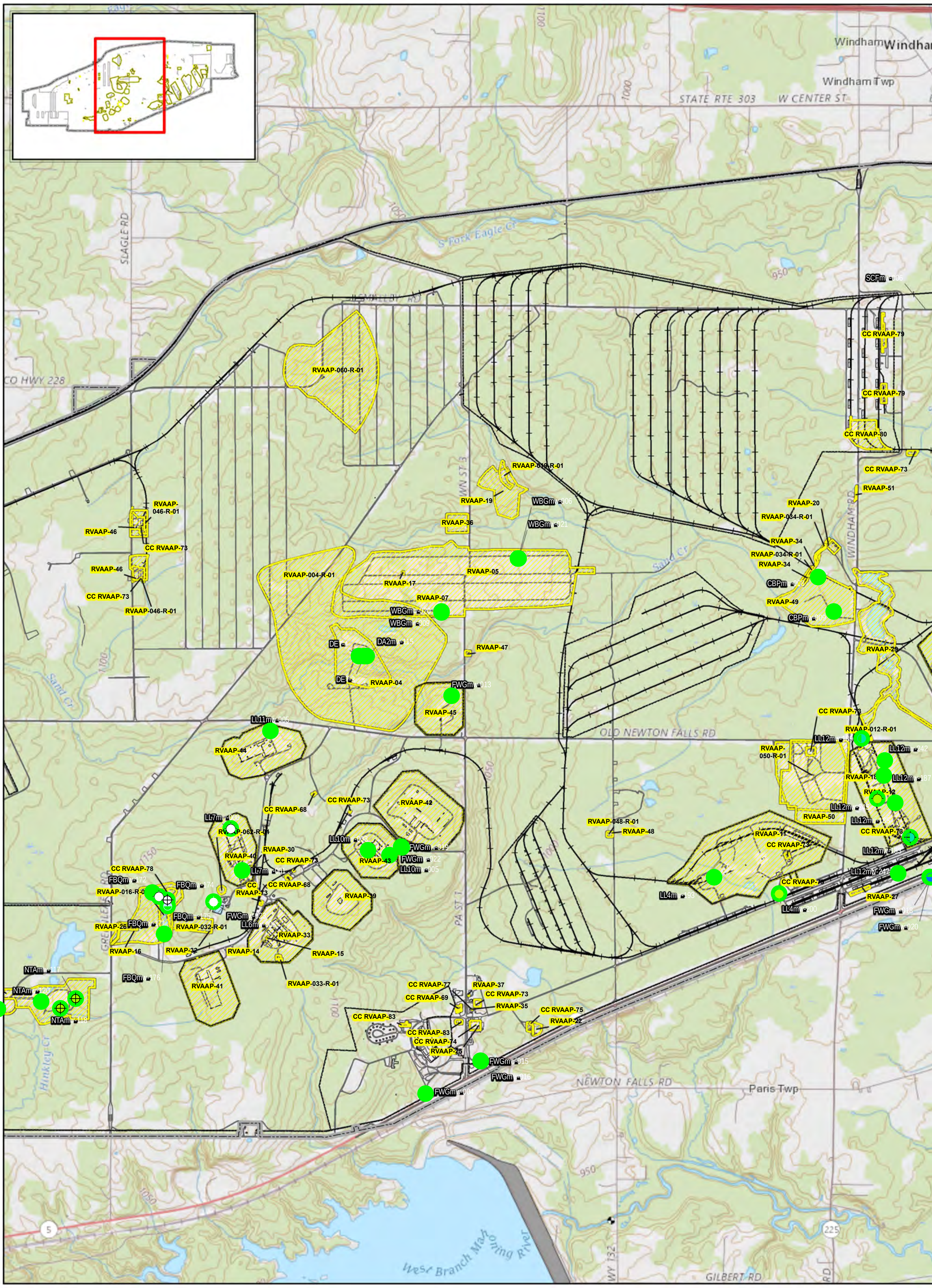
TEC-Weston Joint Venture

2018 FWGWMP WELLS
EAST RVAAP
Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: 3-1

FINAL

Path: C:\gis\GIS_Project_Files\145363_NGB\Ravenna\GIS\MXDs\FWGMP\Fig_1_1-3-3_2018_FWGMP_Sample_Locations_FINAL.mxd 06/18/2018 3:21:36 PM, liua



Legend

- Groundwater Station (Unconsolidated Unit)
- Groundwater Station (Homewood)
- Groundwater Station (Sharon Sandstone)
- Groundwater Station (Sharon Shale)
- Groundwater Station (Sharon Cong.)
- 2018 FWGWMP Sampling Well Location
- Camp Ravenna Boundary
- AOCs/MRSs

N

0 1,300 2,600 3,900 5,200 Feet

1 " = 2,490 ft
NAD83 UTM Zone 17N

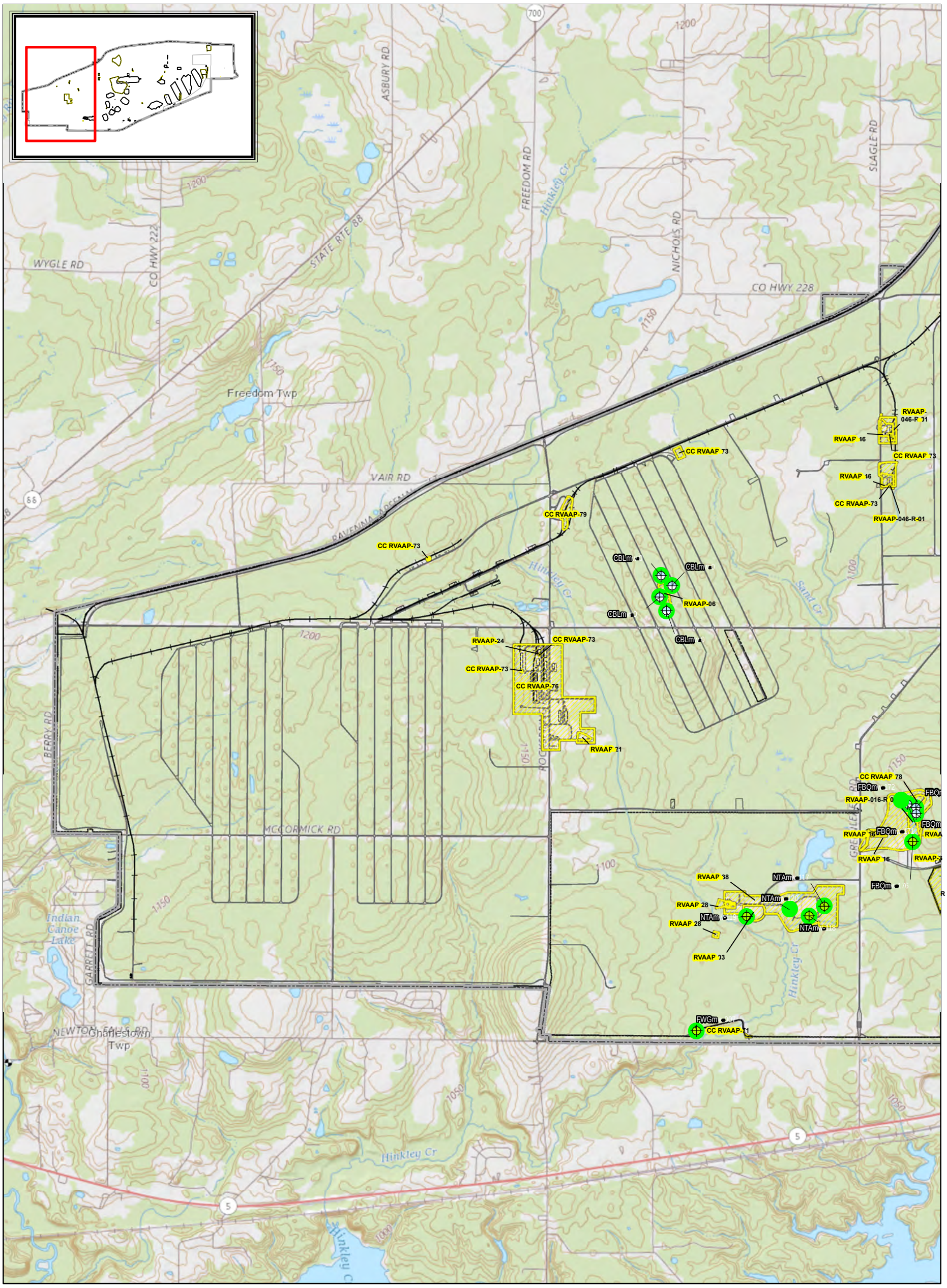
TEC-Weston Joint Venture

2018 FWGWMP WELLS
CENTRAL RVAAP
Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: 3-2

FINAL

Path: C:\gis\GIS_Project_Files\15363_NGB\Ravenna\GIS\MXDs\FWGMP\Fig_1_1-3-3_2018_FWGMP_Sample_Locations_FINAL.mxd, 06/18/2018 3:21:36 PM, liua



Legend

- Groundwater Station (Unconsolidated Unit)
- Groundwater Station (Homewood)
- Groundwater Station (Sharon Sandstone)
- Groundwater Station (Sharon Shale)
- Groundwater Station (Sharon Cong.)
- 2018 FWGWMP Sampling Well Location
- Camp Ravenna Boundary
- AOCs/MRSs

N

0 1,300 2,600 3,900 5,200 Feet

1 " = 2,490 ft
NAD83 UTM Zone 17N

TEC-Weston Joint Venture

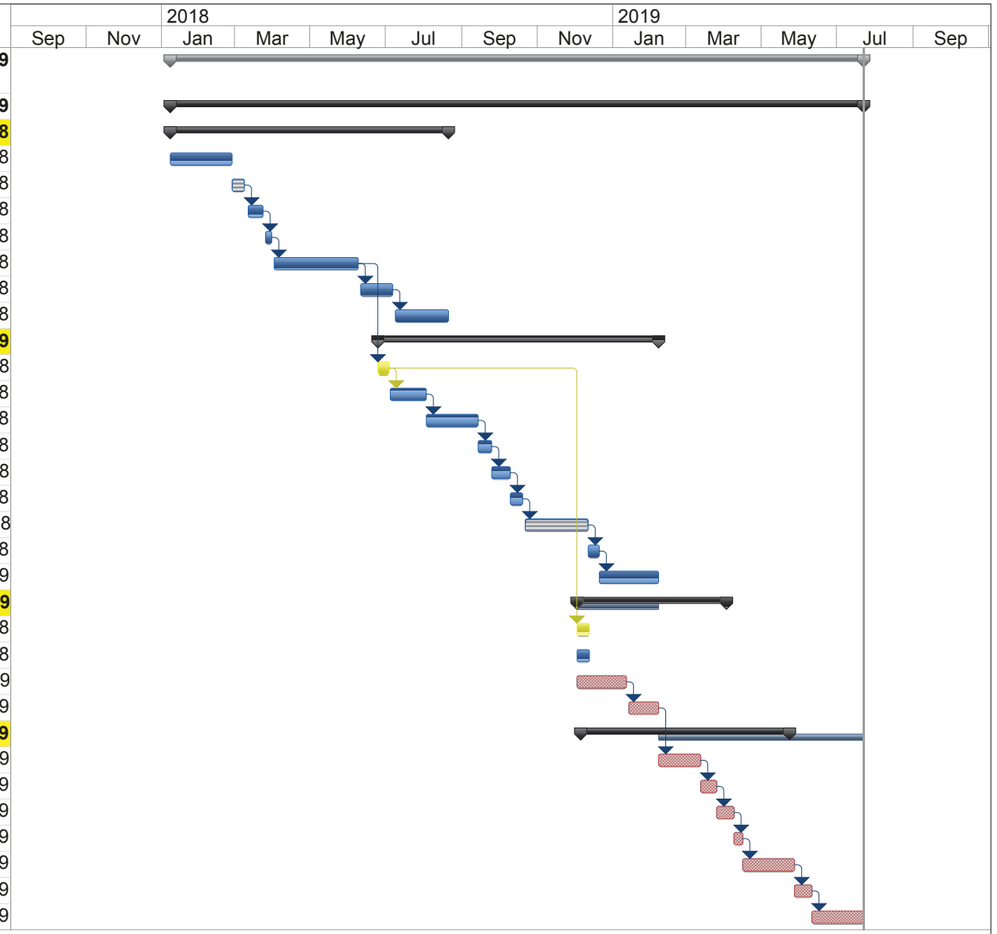
2018 FWGWMP WELLS
WEST RVAAP
Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: 3-3

FINAL

Path: C:\gis\GIS_Project_Files\15363_NGB\Ravenna\GIS\MXDs\FWGMP\Fig_1_1-3-3_2018_FWGMP_Sample_Locations_FINAL.mxd 06/18/2018 3:21:36 PM liua

ID	Task	Task Name	Calendar Days	Start	Finish
0		**Groundwater and Environmental Investigation Services at the Former Ravenna Army Ammunition Plant/Camp Ravenna**	**561 days**	**Mon 1/8/18**	**Mon 7/22/19**
1	**9**	**Routine Groundwater Sampling**	**561 days**	**Mon 1/8/18**	**Mon 7/22/19**
2	**9.10**	**2017 Annual Groundwater Sampling Report and 2018 FWGWMP Addendum**	**225 days**	**Mon 1/8/18**	**Mon 8/20/18**
3	9.10	Prepare Preliminary Draft Report	50 days	Mon 1/8/18	Mon 2/26/18
4	9.10	ARNG Review and Comment	10 days	Tue 2/27/18	Thu 3/8/18
5	9.10	Prepare RTCs and Draft Report	12 days	Mon 3/12/18	Fri 3/23/18
6	9.10	ARNG Review and Comment	5 days	Mon 3/26/18	Fri 3/30/18
7	9.10	Regulator Review Draft Report and Addendum Approval	68 days	Mon 4/2/18	Fri 6/8/18
8	9.10	Prepare RTCs and Final Report	26 days	Mon 6/11/18	Fri 7/6/18
9	9.10	Receive ARNG and Regulatory Approval of Groundwater Sampling Report	43 days	Mon 7/9/18	Mon 8/20/18
10	**9.11**	**Semi-Annual Groundwater Sampling #5**	**227 days**	**Mon 6/25/18**	**Wed 2/6/19**
11	9.11	Semi-Annual GW Sampling #5	9 days	Mon 6/25/18	Tue 7/3/18
12	9.11	Sample Analysis	29 days	Thu 7/5/18	Thu 8/2/18
13	9.11	Prepare Preliminary Draft Semi-Annual Report	42 days	Fri 8/3/18	Thu 9/13/18
14	9.11	ARNG Review and Comment	11 days	Fri 9/14/18	Mon 9/24/18
15	9.11	Prepare RTCs and Draft Semi-Annual Report	15 days	Tue 9/25/18	Tue 10/9/18
16	9.11	ARNG Review and Comment	10 days	Wed 10/10/18	Fri 10/19/18
17	9.11	Regulator Review Draft Report	51 days	Mon 10/22/18	Tue 12/11/18
18	9.11	Prepare RTCs and Final Semi-Annual Report	9 days	Wed 12/12/18	Thu 12/20/18
19	9.11	Receive ARNG and Regulatory Approval of Groundwater Sampling Report	48 days	Fri 12/21/18	Wed 2/6/19
20	**TBD**	**Semi-Annual Groundwater Sampling**	**121 days**	**Mon 12/3/18**	**Tue 4/2/19**
21	TBD	Semi-Annual GW Sampling	10 days	Mon 12/3/18	Wed 12/12/18
22	TBD	Field Work Completion	10 days	Mon 12/3/18	Wed 12/12/18
23	TBD	Sample Analysis	40 days	Mon 12/3/18	Fri 1/11/19
24	TBD	Data Validation	24 days	Mon 1/14/19	Wed 2/6/19
25	**TBD**	**2018 Annual Groundwater Sampling Report and 2019 FWGWMP Addendum**	**169 days**	**Thu 12/6/18**	**Thu 5/23/19**
26	TBD	Prepare Preliminary Draft Report	34 days	Thu 2/7/19	Tue 3/12/19
27	TBD	ARNG Review and Comment	13 days	Wed 3/13/19	Mon 3/25/19
28	TBD	Prepare RTCs and Draft Report	14 days	Tue 3/26/19	Mon 4/8/19
29	TBD	ARNG Review and Comment	7 days	Tue 4/9/19	Mon 4/15/19
30	TBD	Regulator Review Draft Report and Addendum Approval	42 days	Tue 4/16/19	Mon 5/27/19
31	TBD	Prepare RTCs and Final Report	14 days	Tue 5/28/19	Mon 6/10/19
32	TBD	Receive ARNG and Regulatory Approval of Groundwater Sampling Report	42 days	Tue 6/11/19	Mon 7/22/19



Groundwater and Environmental Investigation Services at the Former Ravenna Army Ammunition Plant/Camp Ravenna
Date: Wed 6/20/18

Task — Summary — Field Work Activities (Yellow)
Milestone — Critical — Progress

Figure 4-1
2018 FWGWMP Schedule

TABLES

THIS PAGE INTENTIONALLY LEFT BLANK

Table 3-1 FWGWMP Wells and Rationale

No.	RVAAP-66 Area	Well Location	Rationale/Comments
1	Central Burn Pits	CBPmw-008	**Unconsolidated** monitoring well to be sampled in 2018 for cyanide.
2	Central Burn Pits	CBPmw-009	**Upper Sharon** monitoring well to be sampled in 2018 for cyanide. The historical well result high for total cyanide was reported in 2017.
3	C-Block Quarry	CBLmw-001	**Homewood monitoring well** to be sampled for SVOCs, PCBs, cyanide, metals, including hexavalent chromium, explosives, sulfate/sulfide, nitrate/nitrate, and pH.
4	C-Block Quarry	CBLmw-002	**Homewood monitoring well** to be sampled for SVOCs, PCBs, cyanide, metals, including hexavalent chromium, explosives, sulfate/sulfide, nitrate/nitrate, and pH.
5	C-Block Quarry	CBLmw-003	**Homewood monitoring well** to be sampled for SVOCs, PCBs, cyanide, metals, including hexavalent chromium, explosives, sulfate/sulfide, nitrate/nitrate, and pH.
6	C-Block Quarry	CBLmw-004	**Homewood monitoring well** to be sampled for SVOCs, PCBs, cyanide, metals, including hexavalent chromium, explosives, sulfate/sulfide, nitrate/nitrate, and pH.
7	Erie Burning Grounds	EBGmw-125	**Unconsolidated** monitoring well to be sampled in 2018 for cyanide. The historical well result high for total cyanide was reported in 2017.
8	Erie Burning Grounds	EBGmw-131	**Upper Sharon** monitoring well with historical maximum cyanide concentrations reported in 2016.
9	SE/Load Line 1	LL1mw-064	**Unconsolidated** monitoring well located downgradient from Load Line 1 and serves to monitor potential GW exit pathway off of former RVAAP.
10	SE/Load Line 1	LL1mw-065	**Unconsolidated** monitoring well located downgradient from Load Line 1 and serves to monitor potential GW exit pathway off of former RVAAP.
11	Load Line 1	LL1mw-080	**Upper Sharon** well to be characterized for explosives.
12	Load Line 1	LL1mw-081	**Upper Sharon** well with historical maximum cyanide concentration reported in 2016. Semi-annual sampling in 2018 will include characterization of explosives. Initial nitrobenzene detection of 0.58 µg/L in 2017 exceeds the current screening level.
13	Load Line 1	LL1mw-083	**Upper Sharon** source area well that has consistently been found to contain explosive constituents (2,4,6-TNT, 2,4-DNT, and 4-amino-2,6-DNT). Semi-annual sampling will include characterization of groundwater pH conditions outside the range of naturally occurring conditions.

No.	RVAAP-66 Area	Well Location	Rationale/Comments
14	Load Line 1	LL1mw-084	**Upper Sharon** source area well that has consistently been found to contain explosive constituents (2,4,6-TNT, 2,4-DNT, 4-amino-2,6-DNT, and RDX). Well result high for free cyanide reported in 2017. Semi-annual sampling will include characterization of groundwater pH conditions outside the range of naturally occurring conditions
15	SE/Load Line 1	LL1mw-086	Second water-bearing zone well (**deep unconsolidated**) downgradient of Load Line 1 for monitoring potential GW exit pathway. Semi-annual sampling will include characterization of groundwater pH conditions outside the range of naturally occurring conditions.
16	SE	LL1mw-087	**Unconsolidated** well located approximately downgradient of Load Line 1. Monitors potential GW exit pathway.
17	Load Line 1	LL1mw-088	**Unconsolidated** well located downgradient of Load Line 1 and LL1mw-086, which has historically had pesticides detection above screening levels. Sentinel well for monitoring GW exit pathway outside perimeter fence.
18	Load Line 1	LL1mw-089	**Unconsolidated** well located downgradient of Load Line 1 and LL1mw-086, which has historically had pesticides detection above screening levels. Sentinel well for monitoring GW exit pathway outside perimeter fence.
19	S/Load Line 2	LL2mw-059	**Upper Sharon** well located downgradient of Load Lines 2 and 3 and serves as potential GW exit pathway off of former RVAAP; consistently found to contain explosives. 1,3,5-Trinitrobenzene, tetryl and perchlorate were detected below screening levels in 2017. Historical well result high over screening levels for 1,3-Dinitrobenzene in 2017.
20	Load Line 2	LL2mw-264	**Upper Sharon** monitoring well to be sampled for cyanide due to a well-specific historical maximum result in 2016.
21	Load Line 2	LL2mw-267	**Upper Sharon** source area well that has consistently been found to contain explosive constituents (2,4-DNT and RDX).
22	Load Line 2	LL2mw-272	**Upper Sharon** well installed in 2016 on the southwest interior of Load Line 2 to further characterize the nature and extent of facility-wide groundwater impacts. Total cyanide reported in 2017 over the screening level.
23	Load Line 2/Facility-Wide	FWGmw-017	**Basal Sharon Conglomerate** exit pathway well installed at the post boundary southeast of Load Line 2 to further characterize the nature and extent of facility-wide groundwater impacts. Non-metals constituents reported with detected concentrations include acetone and naphthalene under their respective screening levels.

No.	RVAAP-66 Area	Well Location	Rationale/Comments
24	Facility-Wide	FWGmw-024	**Upper Sharon** exit pathway well installed at the post boundary southeast of Load Line 2 to further characterize the nature and extent of facility-wide groundwater impacts. Non-metals constituents (other than hexavalent chromium) reported with detected concentrations include naphthalene and nitrobenzene. Nitrobenzene was reported below its FWCUG but over the current USEPA Tapwater RSL in April 2017. Hexavalent chromium was also reported over the Tapwater RSL in April 2017.
25	Load Line 3	LL3mw-234	**Upper Sharon** well with historical well-specific maximum cyanide concentration observed in 2016.
26	Load Line 3	LL3mw-237	**Upper Sharon** well to be sampled for potentially increasing explosives concentrations. Primary source area well for explosive constituents. Exit pathway well.
27	Load Line 3	LL3mw-244	**Upper Sharon** well located downgradient of Load Lines 3 and 12; consistently found to contain low level explosive constituents (2-amino-4,6-DNT, 4-amino-2,6- DNT, and RDX) and hexavalent chromium. Exit pathway well with detected explosive constituents nitrobenzene and RDX below screening levels in 2017.
28	Load Line 3	LL3mw-246	**Upper Sharon** well located downgradient of Load Lines 3 and 12 and affected well LL3mw-244; serves as potential GW exit pathway off of former RVAAP; low levels of explosives consistently identified in well. RDX, 4-amino-2,6-dinitrotoluene, and perchlorate were detected below screening levels in 2017.
29	Load Line 3/Facility-Wide	FWGmw-021	**Upper Sharon** exit pathway well installed at the post boundary southwest of Load Line 3 in 2016 to further characterize the nature and extent of facility-wide groundwater impacts. Nitrobenzene, RDX, acetone, naphthalene and perchlorate were detected below screening levels in 2017. 2-amino-4,6-dinitrotoluene, 4-Amino-2,6-dinitrotoluene, total cyanide, and aroclor-1254 were reported over screening levels 2017.
30	Load Line 4	LL4mw-193	**Unconsolidated** well to be sampled for cyanide due to well-specific historical high concentrations in 2016.
31	Load Line 4	LL4mw-200	**Unconsolidated** well with historical well-specific maximum cyanide concentration observed in 2016. Exit pathway well for Load Line 4.
32	Load Line 7	LL7mw-001	**Homewood** source area well that has historically been found to contain chlorinated solvents (specifically 1,1- dichloroethane, 1,1-dichloroethene, and 1,1,1- trichloroethane). Historical well result high for total cyanide in 2017.
33	Load Line 7	LL7mw-006	**Homewood** source area well representing primary contaminant (RDX) source area conditions at LL7. Historical well result high for RDX in 2017.

No.	RVAAP-66 Area	Well Location	Rationale/Comments
34	Load Line 10	LL10mw-003	**Homewood** well that has had historically consistent occurrence of VOCs (specifically carbon tetrachloride). Historical well results high or first detection for nitrobenzene, carbon Tetrachloride, and chloroform in 2017.
35	Load Line 10	LL10mw-005	**Homewood** well paired with FWGmw-022; serves to assess potential vertical contaminant migration in this area of the site.
36	Facility-Wide	FWGmw-019	**Basal Sharon Conglomerate** vertical delineation well installed between Load Line 9 and Load Line 10 to further characterize the nature and extent of facility-wide groundwater impacts. Total cyanide, aroclor-1254, and chloroform were detected above screening levels in 2017.
37	Facility-Wide	FWGmw-022	**Upper Sharon** vertical delineation well installed between Load Line 9 and Load Line 10 to further characterize the nature and extent of facility-wide groundwater impacts. Aroclor-1254, total cyanide, and chloroform were detected above screening levels in 2017.
38	Load Line 11	LL11mw-005	**Unconsolidated** well with AOC historical maximum concentration for cyanide in 2016 results.
39	Load Line 12	LL12mw-183	**Upper Sharon** monitoring well with well-specific historical maximum cyanide reported in 2016. Cyanide and benz(a)anthracene concentrations reported over screening levels in 2017.
40	Load Line 12	LL12mw-185	**Unconsolidated** well that has been found to contain elevated levels of nitrate and is downgradient of potential arsenic source. Initial nitrate and total cyanide detections in 2016 over screening levels.
41	Load Line 12	LL12mw-187	**Unconsolidated** well that has been found to contain elevated levels of nitrate. Historical constituent high for nitrate in 2017.
42	Load Line 12	LL12mw-242	**Unconsolidated** well located downgradient of a potential arsenic source area in the vicinity of LL12mw-113.
43	Load Line 12	LL12mw-245	**Unconsolidated** well located downgradient of potential nitrate source in the area of LL12mw-185.
44	SE	LL12mw-247	**Unconsolidated** well located downgradient of Load Line 12. Total and free cyanide were reported over screening levels in 2017. Nitrobenzene and nitrate detected below screening levels in 2017. Monitors potential GW exit pathway.
45	Load Line 12/Facility-Wide	FWGmw-018	**Basal Sharon Conglomerate** exit pathway well installed at the post boundary south of Load Line 12 to further characterize the nature and extent of facility-wide groundwater impacts. Ethylbenzene, total xylene, benzyl alcohol, and naphthalene were detected below screening levels in 2017. Aroclor-1254 was reported over its screening level.
46	Load Line 12/Facility-Wide	FWGmw-020	**Upper Sharon** exit pathway well installed at the post boundary southeast of Load Line 12 to further characterize the nature and extent of facility-wide groundwater impacts. Acetone and naphthalene were detected below screening levels in 2017. Cyanide was detected over its screening level.

No.	RVAAP-66 Area	Well Location	Rationale/Comments
47	Fuze and Booster	FBQmw-171	**Homewood** monitoring well with historical maximum cyanide concentration reported in 2016 and anomalous pH values outside the typical range of natural groundwater.
48	Fuze and Booster	FBQmw-172	**Homewood** monitoring well with historical maximum cyanide concentration reported in 2016 and free cyanide above screening levels in 2017.
49	Fuze and Booster	FBQmw-174	**Homewood** source area well that has consistently been found to contain explosive constituents (2,4-DNT, 2,4,6- TNT, and 4-amino-2,6-DNT). Monitored for pH values outside the typical range of natural groundwater.
50	Fuze and Booster	FBQmw-175	**Homewood** source area well with anomalous pH values outside the typical range of natural groundwater.
51	Fuze and Booster	FBQmw-176	**Unconsolidated** source area well representing primary contaminant (cyanide) source area conditions at the AOC.
52	Facility-Wide	FWGmw-023	**Upper Sharon** well installed east of the Fuze and Booster Quarry to further characterize the nature and extent of facility-wide groundwater impacts. Total cyanide, chloroform, and ethylbenzene were reported over screening levels in 2017.
53	Admin/George Road	FWGmw-004	**Unconsolidated** exit pathway well located near the south property line and downgradient of several Compliance Restoration sites. RDX and bis(2-Ethylhexyl)phthalate were detected below screening levels in 2017.
54	SW	FWGmw-007	**Unconsolidated** well located in the western portion of former RVAAP. Potential exit pathway well near Hinkley Creek.
55	Northeast of LL1	FWGmw-010	**Unconsolidated** monitoring well with new well-specific historical high cyanide concentrations in 2016.
56	East Classification Yard	FWGmw-011	**Unconsolidated** well located east of Ramsdell Quarry and former East Classification Yard. Serves as exit pathway well. Historical well result high for 3-Nitrotoluene in 2017.
57	East Classification Yard	FWGmw-012	**Upper Sharon** formation well paired with FWGmw-011; serves as exit pathway well for the Sharon aquifer.
58	Facility-Wide	FWGmw-013	**Upper Sharon** well with historical well-specific maximum cyanide concentration reported in 2017.
59	Admin/George Road	FWGmw-015	**Unconsolidated** well. Located near the south property line and downgradient of several Compliance Restoration sites. Serves as first-water unconsolidated exit pathway well.
60	Admin/George Road	FWGmw-016	**Upper Sharon** well paired with FWGmw-015 for vertical delineation. Located near the south property line and downgradient of several Compliance Restoration sites. Serves as upper Sharon formation exit pathway well. RDX was detected below screening levels in 2017.
61	NACA Test	NTAmw-117	**Unconsolidated** monitoring well with well-specific historical maximum cyanide concentrations reported in 2016.
62	NACA Test	NTAmw-118	**Unconsolidated** monitoring well with AOC historical maximum cyanide concentrations reported in 2016.

No.	RVAAP-66 Area	Well Location	Rationale/Comments
63	NACA Test	NTAmw-119	**Deep unconsolidated** well that has historically been found to contain trace amounts of tetrachloroethene, naphthalene, as well as metals. Monitors second water-bearing zone in buried glacial valley. Historical constituent high for Benzo(b)fluoranthene in 2017.
64	NACA Test	NTAmw-120	**Upper Sharon** well installed in 2016 at the central portion of the NACA Test Area to further characterize the nature and extent of facility-wide groundwater impacts. Non-metals constituents were not reported above screening levels in samples collected in 2017.
65	Demo. Area 2	DA2mw-115	**Upper Sharon** well paired with well DETmw-003; serves to monitor potential vertical migration in this area of the site. Historical well result high for Total Cyanide in 2017.
66	Demo. Area 2	DETmw-003	**Unconsolidated** RCRA well. Initial nitrobenzene detection 2017 over its screening level. Benzo(b)fluoranthene and cyanide reported over screening levels in 2017.
67	Demo. Area 2	DETmw-004	**Unconsolidated** RCRA well. Dry during both semi-annual events in 2017.
68	Ramsdell Quarry	RQLmw-007	**Upper Sharon** RCRA well. Historical well result high for benzo(b)fluoranthene in 2017. Cyanide detected above screening levels in 2016. Phosphorous reported over screening levels in 2017.
69	Ramsdell Quarry	RQLmw-008	**Upper Sharon** RCRA well. Historical well result high for 3-nitrotoluene in 2017 and cyanide in 2016.
70	Ramsdell Quarry	RQLmw-009	**Upper Sharon** RCRA well. First detection for cyanide reported in 2016.
71	Ramsdell Quarry	RQLmw-011	**Upper Sharon** source area well with anomalous pH values outside the typical range of natural groundwater and historically representing SVOC primary contaminant source area conditions at the AOC.
72	Ramsdell Quarry	RQLmw-012	**Upper Sharon** source area well with anomalous pH values outside the typical range of natural groundwater and well-specific historical maximum cyanide concentrations reported in 2016 and free cyanide above screening levels in 2017.
73	Ramsdell Quarry	RQLmw-013	**Upper Sharon** source area well with anomalous pH values outside the typical range of natural groundwater.
74	Ramsdell Quarry	RQLmw-014	**Upper Sharon** source area well with anomalous pH values outside the typical range of natural groundwater. Historically reported as the primary contaminant (2-nitrotoluene) source area conditions at the AOC.
75	Ramsdell Quarry	RQLmw-016	**Upper Sharon** monitoring well with historical maximum cyanide concentrations reported in 2016.
76	SE	SCFmw-004	**Sharon Conglomerate Member** well located downgradient of Load Lines 1 and 2, paired with LL1mw- 087, and selected for monitoring the potential GW exit pathway off of former RVAAP in the deeper aquifer.

No.	RVAAP-66 Area	Well Location	Rationale/Comments
77	Winklepeck	WBGmw-006	**Unconsolidated** well paired with WBGmw-021; source area well has been found to contain explosives (RDX).
78	Winklepeck	WBGmw-009	**Unconsolidated** well paired with WBGmw-020; source area well has been found to contain explosive constituents (RDX).
79	Winklepeck	WBGmw-020	**Upper Sharon** well paired with WBGmw-009; source area well for monitoring potential vertical migration in Sharon aquifer.
80	Winklepeck	WBGmw-021	**Upper Sharon** well paired with WBGmw-006; source area well for monitoring potential vertical migration in Sharon aquifer.

Table 3-2 FWGWMP Wells with Analytical Testing Suite

Well ID	VOCs	SVOCs	PCBs	Explosives	Pesticides	Cyanide	Other	Metals
CBPmw-008						X		
CBPmw-009						X		
CBLmw-001		X	X	X		X	Sulfate/Sulfide, Nitrate/Nitrite, pH	X + Cr[VI]
CBLmw-002		X	X	X		X	Sulfate/Sulfide, Nitrate/Nitrite, pH	X + Cr[VI]
CBLmw-003		X	X	X		X	Sulfate/Sulfide, Nitrate/Nitrite, pH	X + Cr[VI]
CBLmw-004		X	X	X		X	Sulfate/Sulfide, Nitrate/Nitrite, pH	X + Cr[VI]
DA2mw-115		X[2]		X		X		X
DET-003	X	X[2,3,4,5]	X	X	X	X		X
DET-004	X	X[2,3,4,5]	X	X	X	X		X
EBGmw-125						X		
EBGmw-131						X		
FBQmw-171						X	Sulfate/Sulfide, Nitrate/Nitrite, Alkalinity	Cr[VI]
FBQmw-172						X		
FBQmw-174		X[2]		X	X		Sulfate/Sulfide, Nitrate/Nitrite, Alkalinity	Cr[VI
FBQmw-175							Sulfate/Sulfide, Nitrate/Nitrite, Alkalinity	Cr[VI]
FBQmw-176						X		
FWGmw-004		X[2]		X				X
FWGmw-007		X[2]		X				X

Well ID	VOCs	SVOCs	PCBs	Explosives	Pesticides	Cyanide	Other	Metals
FWGmw-010						X		
FWGmw-011		X[2]		X				X
FWGmw-012		X[2]		X				X
FWGmw-013						X		
FWGmw-015		X[2]		X				X
FWGmw-016		X[2]		X				X
FWGmw-017	X	X		X			X[1] (Perchlorate, Nitroguanidine, Nitrocellulose)	X + Cr(VI)[1]
FWGmw-018	X	X	X	X		X	X[1] (Perchlorate, Nitroguanidine, Nitrocellulose)	X + Cr(VI)[1]
FWGmw-019	X	X[1]	X			X	X[1] (Perchlorate, Nitroguanidine, Nitrocellulose)	Cr(VI)[1]
FWGmw-020	X	X	X	X		X	X[1] (Perchlorate, Nitroguanidine, Nitrocellulose, Nitrate)	X + Cr(VI)
FWGmw-021	X	X	X	X	X	X	X[1] (Perchlorate, Nitroguanidine, Nitrocellulose)	X + Cr(VI)[1]
FWGmw-022	X	X[1]	X			X	X[1] (Perchlorate, Nitroguanidine, Nitrocellulose)	Cr(VI)[1]
FWGmw-023	X[1]	X[1]				X	X[1] (Perchlorate, Nitroguanidine, Nitrocellulose)	Cr(VI)[1]
FWGmw-024	X	X		X			X[1] (Perchlorate, Nitroguanidine, Nitrocellulose)	X + Cr(VI)
LL1mw-064				X				X
LL1mw-065		X[2]		X				X
LL1mw-080				X				
LL1mw-081				X		X		

Well ID	VOCs	SVOCs	PCBs	Explosives	Pesticides	Cyanide	Other	Metals
LL1mw-083		X[2]		X	X		Sulfate/Sulfide, Nitrate/Nitrite, Alkalinity	Cr[VI]
LL1mw-084		X[2]		X	X	X	Sulfate/Sulfide, Nitrate/Nitrite, Alkalinity	X + Cr[VI]
LL1mw-086		X[2]		X			Alkalinity	X
LL1mw-087		X[2]		X				X
LL1mw-088		X[2]		X	X		Alkalinity	X
LL1mw-089		X[1]		X[1]		X	X[1] (Perchlorate, Nitroguanidine, Nitrocellulose)	Cr(VI)[1]
LL2mw-059		X[2]		X				X
LL2mw-264						X		
LL2mw-267		X[2]		X				X
LL2mw-272		X[1]		X[1]		X	X[1] (Perchlorate, Nitroguanidine, Nitrocellulose)	Cr(VI)[1]
LL3mw-234						X		
LL3mw-237				X				
LL3mw-244		X[2]		X	X			X + Cr(VI)
LL3mw-246		X[2]		X			Perchlorate	X
LL4mw-193						X		
LL4mw-200						X		
LL7mw-001	X	X[2]		X		X		X
LL7mw-006				X				
LL10mw-003	X	X[2,3]						X
LL10mw-005	X	X[2,3]						X
LL11mw-005						X		
LL12mw-183		X[4]				X		

Well ID	VOCs	SVOCs	PCBs	Explosives	Pesticides	Cyanide	Other	Metals
LL12mw-185						X	Nitrate	Arsenic
LL12mw-187		X[2]					Nitrate	X
LL12mw-242		X[2]		X			Nitrate	X
LL12mw-245		X[2]		X			Nitrate	X
LL12mw-247		X[2]		X		X	Nitrate	X + Cr(VI)
NTAmw-117						X		
NTAmw-118						X		
NTAmw-119	X	X[2,3,4]		X				X
NTAmw-120		X[1]		X[1]			X[1] (Perchlorate, Nitroguanidine, Nitrocellulose)	Cr(VI)[1]
RQLmw-007	X	X[2,4,5]	X	X	X	X	Phosphorus	X
RQLmw-008	X	X[2,4,5]	X	X	X	X		X
RQLmw-009	X	X[2,4,5]	X	X	X	X		X
RQLmw-011		X					Sulfate/Sulfide, Nitrate/Nitrite, Alkalinity	Cr[VI]
RQLmw-012						X	Sulfate/Sulfide, Nitrate/Nitrite, Alkalinity	Cr[VI]
RQLmw-013							Sulfate/Sulfide, Nitrate/Nitrite, Alkalinity	Cr[VI]
RQLmw-014				X			Sulfate/Sulfide, Nitrate/Nitrite, Alkalinity	Cr[VI]
RQLmw-016						X		
SCFmw-004		X[2]		X	X			X
WBGmw-006		X[2]		X				X
WBGmw-009		X[2]		X				X
WBGmw-020		X[2]		X				X

Well ID	VOCs	SVOCs	PCBs	Explosives	Pesticides	Cyanide	Other	Metals
WBGmw-021		X[2]		X				X

Notes:

X - indicates well or constituent to be sampled as part of the 2018 FWGWMP. Wells and constituents will be sampled semi-annually unless indicated by footnotes described below.

[1] Indicates monitoring well or constituents to be sampled in Spring 2018 due to missed tests or rejected results in 2017. Additional sampling during 2018 for these wells and constituents will be based on review of Spring 2018 results.

[2] SVOCs: phthalates

[3] SVOCs: nitroaromatics

[4] SVOCs: polycyclic aromatic hydrocarbons

[5] SVOCs: phenols

Table 3-3 Analytical Laboratory Test Methods

Constituents	Method[1]
Polychlorinated biphenyls (PCBs)	Gas Chromatography (GC) – Semivolatile Organics (SVOCs) (8082A)
Pesticides	GC Semivolatile Organics (8081B)
Base/Neutrals and Acids (SVOCs)	GC/Mass Spectrometry (MS) Semivolatile Organics (8270C)
Polycyclic Aromatic Hydrocarbons (PAHs)	8270D SIM
Volatile Organic Compounds (VOCs)	GC/MS Volatile Organics (8260B)
Nitroguanidine (Propellant)	Organic compounds by UV/HPLC (8330 modified)
Nitroaromatics & Nitramines (Explosives)	GC Semivolatile Organics Explosives (8330)
Nitrocellulose (Propellant)	Colorimetric Cadmium Reduction 353.2[2]
Nitrate/Nitrites	General Chemistry (353.2)[2]
Total Alkalinity	SM2320B
Cyanide (Total)	General Chemistry (9012B)
Metals (Magnesium, Manganese, Barium, Nickel, Potassium, Silver, Sodium, Vanadium, Chromium, Calcium, Cobalt, Copper, Arsenic, Lead, Selenium)	Inductively Coupled Plasma (6010B)
Metals (Antimony, Iron, Beryllium, Thallium, Zinc, Cadmium, Aluminum)	Inductively Coupled Plasma Mass Spectrometry (6020); 6010C
Hexavalent Chromium	7196A
Mercury	Liquid Waste Cold Vapor Technique (7470A)
Perchlorate	Method 6860

Notes:

[1] USEPA SW846

[2] USEPA Methods for Chemical Analysis of Water and Waste

APPENDIX A
COMMENT RESPONSE TABLE

THIS PAGE INTENTIONALLY LEFT BLANK

NATIONAL GUARD BUREAU
111 SOUTH GEORGE MASON DRIVE
ARLINGTON VA 22204-1373

June 1, 2018

Ohio Environmental Protection Agency
DERR-NEDO
Attn: Kevin Palombo
2110 East Aurora Road
Twinsburg, OH 44087-1924

Subject: Response to Comments – Draft Facility-Wide Groundwater Monitoring Addendum for 2018
Camp Ravenna, Portage and Trumbull Counties, Ohio
Ohio EPA ID # 267-000859-036
Contract Number: W9133L-14-D-0008
Task Order Number: 0003

Dear Mr. Kevin Palombo:

The Army National Guard is pleased to submit the enclosed Comment Resolution Table to Comments on the Draft Facility-Wide Groundwater Monitoring Addendum for 2018. This deliverable is in response to Ohio EPA comments dated 17 May 2018. This deliverable consists of one hardcopy and one electronic copy containing a single pdf of the submission.

Please contact the undersigned at (703) 601-7785 or james.c.crowley.mil@mail.mil if you would like to discuss this submission.

Sincerely,

CROWLEY.JAMES.CORNELIUS.1045120399

Digitally signed by CROWLEY.JAMES.CORNELIUS.1045120399
Date: 2018.05.31 13:26:14 -04'00'

James C. Crowley
Lieutenant Colonel, Corps of Engineers
RVAAP Restoration Program Manager
Army National Guard Installations & Environment

CC:
Thomas Schneider, Ohio EPA, SWDO
Mark Johnson, Ohio EPA, DERR-NEDO
Al Muller, Ohio EPA, DERR-NEDO
Bob Princic, Ohio EPA, DERR-NEDO
Kevin Sedlak, ARNG, Camp Ravenna
Katie Tait, OHARNG, Camp Ravenna
Rebecca Shreffler, OHARNG, Camp Ravenna
Brent Ferry, JV Project Manager

Comment Resolution Table

Installation: Camp Ravenna/Former RVAAP
Document: Comments on the Draft Facility-Wide Groundwater Addendum for 2018
Reviewer(s): Kevin M. Palombo, Ohio EPA, (330) 963-1292
Date: 17 May 2018

Cmt No.	Page or Sheet	Comment	Response
1	General	Ohio EPA previously reviewed the August 2017 *Draft RI/FS Report for the Soil, Sediment, and Surface Water at RVAAP-06 C Block Quarry.* Ohio EPA also reviewed the National Guard's March 2018 response letter to Ohio EPA's comments dated November 28, 2017, regarding that document. Based on that review, Ohio EPA concluded that the SESOIL™/AT123D™ model used in the C Block Quarry RI/FS does not accurately predict contaminant migration through the highly heterogenous hydrogeologic system such as exists beneath C Block Quarry. The geology beneath C Block Quarry consists of a thin layer of soil/unconsolidated material over fractured and weathered Homewood Sandstone. While part of the vadose zone consists of unconsolidated material soil, most of the vadose zone is in the fractured and weathered Homewood Sandstone. SESOIL™/AT123D™ are not appropriate screening tools to model fate and transport in bedrock or in non-homogenous or fractured geologic media. During the 1950s and 1960s, C Block Quarry was used as a disposal area for annealing process waste. Liquid waste was dumped on the ground surface in the bottom of the quarry. The SESOIL™/AT123D™ model does not consider the direct disposal of wastes onto the weathered and fractured bedrock, as has been reported to have been historically practiced in the 1950s and 1960s in C Block Quarry. The four RI wells (CBLmw-001, CBLmw-002, CBLmw-003, and CBL-004) located in the C Block Quarry Area have not been sampled since 2013. According to the 2016 *RI Work Plan for Ground Water,* the four RI wells in the C Block Quarry need to be sampled to support the Facility-Wide Ground Water (FWGW) RI. Considering the potential for impact to the uppermost hydrostratigraphic unit (Homewood Sandstone) beneath C Block Quarry, and that RI wells in that area have not been sampled in about five years, Ohio EPA recommends that these four wells be added to the list of FWGWMP wells to be sampled in the *Facility-Wide Ground Water Monitoring Addendum for 2018.* Ohio EPA recommends that these four wells be sampled for the parameters specified in the 2016 *RI Work Plan for Ground Water* for C Block Quarry wells including: SVOCs; metals, including hexavalent chromium; and PCBs. Considering the history, disposal practices and pH issues in the C Block, Ohio EPA recommends that these four wells also be sampled for explosives, nitrate/nitrite, sulfate/sulfide, and pH. Ohio EPA recommends that the four C Block Quarry RI wells be sampled for a minimum of two consecutive sampling events and be added to the list of wells to be sampled in 2018 in the Facility-Wide Ground Water Monitoring Addendum.	Sampling was conducted at the C-Block Quarry in Fall 2016 as part of the FWGW RI and in accordance with Table 3-3 of the approved Final RI Work Plan. Results for CBLmw-001, CBLmw-002, CBLmw-003 and CBLmw-004 indicated non-detect SVOC, PCB and cyanide concentrations. Explosives constituents have not been historically detected above current screening levels in CBL monitoring wells and so they were not included in the proposed FWGW RI sampling at the site. The potential need for additional evaluation of metals, including hex chrome, as part of the FWGW RI was intended to be addressed following approval of the background study. Based on review of the Final FWGW RI Work Plan content, it appears that OEPA likely intended to attribute the requirement for characterization of explosives and metals (including hex chrome) to the conclusions of the August 2017 Revised Draft RI/FS for Soil, Sediment and Surface Water at RVAAP-06 C Block Quarry. TEC-WESTON concurs with the conclusions of the Revised Draft RI/FS for Soil, Sediment and Surface Water at RVAAP-06 C Block Quarry as they relate to the need for an updated characterization of metals at the site. As requested by OEPA, the first semi-annual sampling activities of 2018 will include samples collected from CBLmw-001, CBLmw-002, CBLmw-003, and CBLmw-004 for analysis of SVOCs; metals, including hexavalent chromium; PCBs; explosives; nitrate/nitrite; sulfate/sulfide; and pH.